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ABSTRACT

This final report on field testing of minicourses in undergraduate biology lists the objectives, procedures, applications, and conclusions of the project in which twelve schools utilizing minicourses, developed at Purdue University, were sampled. Data were collected and analyzed on student achievement, student attitude changes, and student reaction to the minicourse materials. The data were then used to revise and improve the minicourses where weaknesses in content or approach were detected during the field testing. A scale to measure student attitudes toward biology was developed by the project staff along with an instrument allowing students to record their feelings about various aspects of the minicourse. (Author/CS)

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FINAL REPORT

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on

THE EVALUATION OF MINICOURSES IN UNDERGRADUATE BIOLOGY AT TWELVE SELECTED COLLEGES AND UNIVERSITIES

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ABSTRACT

The final report on field testing of minicourses in undergraduate biology lists the objectives, procedures, applications and conclusions. Twelve schools mostly in the Midwest utilized minicourses developed at Purdue University in their regular classes. Data were collected and analyzed on student achievement, student attitude changes, and student reaction to the minicourse materials. The data were tnen used to revise and improve the minicourses where weaknesses in content or approach were detected during the field testing. A scale to measure student attitudes toward biology was developed by the project staff along with an instrument allowing students to record their feelings about various aspects of a minicourse. The project demonstrated the positive consequences of using field-gathered data for improving the quality of instructional materials.

INTRODUCTION

In 1970 the Minicourse Development Project was instituted at Purdue University by Dr. S.N. Postlethwait. The project was ~~sponsored~~ supported by the National Science Foundation. During the first three years, efforts were concentrated on the design and development of minicourses. After student tryout of these minicourses at Purdue University, it was decided to launch a formal field testing program at twelve other colleges and universities. A two and one-half year evaluation grant was funded by the National Science Foundation in July of 1972. Actual testing of materials began in September of 1972. The field testing was coordinated by James Russell of Purdue's Department of Education and Don Tolliver of the Instructional Media Research Unit at Purdue under the leadership of Dr. Postlethwait.

STATEMENT OF THE PURPOSE

The general objectives of the evaluation phase of the Minicourse Development Project were:

1. To provide corrective feedback information to the project staff about the effectiveness of the materials produced with suggestions for future development strategies.
2. To determine whether the materials allow the students to master the objectives under various field conditions using a variety of student populations.
3. To introduce the minicourse approach and disseminate the modular materials to several divergent types of colleges and universities.

Thus, the purpose of the project was to determine the overall effectiveness of minicourses rather than to compare minicourses with conventional instruction. The basic questions to be answered were: "Are minicourses an effective form of instruction?" and "How can their effectiveness be increased?"

PROCEDURES

Six minicourses were selected for use in the twelve participating schools to provide a common base for evaluation. Each school selected approximately six additional minicourses to use during each term. The design for the field testing procedures is outlined in Figure 1 (next page). The evaluation phase of the project concerned itself with three general concerns: A) assessment of the quality of the minicourses as perceived by students using them, B) assessment of student achievement as a function of using the minicourses, and C) assessment of changes in student

Treatment	TERM						
	Beginning	During					After
		mc_1	mc_2	mc_3	mc_4	mc_5	mc_6	
Control	Pre B (unrelated) Achievement	E_1	E_2	E_3	E_4	E_5	E_6	Post A Achievement
	Attitude Scale							Attitude Scale
Experimental	Pre A (related) Achievement	E_1	E_2	E_3	E_4	E_5	E_6	Post
	Attitude Scale Scale							Attitude Scale

Figure 1. Experimental design for field testing of Audio-Tutorial Minicourses.

attitudes toward biology as a result of the minicourse mode of instruction.

A) Assessment of minicourse quality

The evaluation attempted to determine whether or not students felt:

(1) The objectives of minicourses were achieved;

(2) the audio portions, Study Guides, handouts, visuals, specimens and models were of high quality; and

(3) The minicourses were relevant to student needs. Such information was useful to developers in making revisions and modifications in minicourse content and activities.

The main instrument used to assess minicourse quality is contained in Appendix A. The following five-point scale was used to record responses.

SA = Strongly Agree = 5
A = Agree = 4
N = Neutral = 3
D = Disagree = 2
SD = Strongly Disagree = 1

For each of the questions, the frequency of response (A, B, C, D, E) was determined. Also, the mean was computed for each response. A sample computerized printout of this data is contained in Appendix B.

This questionnaire, designed to assess perceptions of minicourse quality, was administered to a variety of populations. Such populations varied in terms of total enrollment in the respective colleges or universities, class size, and student academic background and abilities.

B) Assessment of student achievement

The evaluation phase of the project was also concerned with determining to what extent students were able to master minicourse content. Achievement measures were available for most of the minicourses tested. In order to assess achievement, a pretest-posttest experimental design was used. Generally, students were given a pretest at the start of a term, were given a posttest immediately after completing each minicourse, and were administered a delayed posttest at the end of the term. Thus, it was possible to determine how much the students had learned from the minicourse by comparing gains in achievement from the pretest to the immediate posttest. It was also possible to determine the amount of retention by comparing immediate posttest scores with delayed posttest scores. A sample of achievement results for one semester at one of the participating schools is shown in Appendix C.

A necessary part of this phase of the evaluation concerned the development of valid instruments to assess achievement. Therefore, for each achievement test, it was necessary to examine item difficulty, effectiveness of distractors, and the ability of the items to discriminate between high-scoring and low-scoring students. In short, it was necessary to conduct an extensive item analysis. A sample of such an item analysis of one minicourse achievement test is shown in Appendix D.

C) Assessment of student attitudes

A third aspect of the evaluation project concerned the assessment of student attitudes toward biology as a function of the minicourse mode of instruction. Specifically, the purpose of this aspect of the evaluation program was to determine the extent to

which the minicourses influenced student attitudes. Although the assessment of attitudes was a less integral part of the evaluation program than the assessment of minicourse quality or student achievement, it was thought that such information would be valuable to developers and future users of the minicourses. Appendix E contains the student attitude scale which was developed by the Minicourse Development Project evaluation staff.

APPLICATION AND DISSEMINATION

The primary application of the findings from the field testing was in the revision and improvement of the minicourses before their release for publication. The data from the student tryout were forwarded to BSCS in Boulder, Colorado, where a team of instructional developers under the direction of Dr. Postlethwait implemented the necessary changes within the minicourses. Where major revisions were necessary, the minicourse was re-evaluated.

The field testing and evaluation procedures developed as a part of this project were applied to a number of additional projects in a variety of instructional disciplines. Dr. Russell used the procedures with minor modification as part of a U.S. Public Health Service grant to develop minicourses in medical-surgical nursing. The techniques were also used by the Laboratory for Applications of Remote Sensing at Purdue University. In addition, Dr. Tolliver applied the appropriate parts of the research in an EXXON Education Project which he directed. The EXXON Project developed twelve minicourses to be used for pre-service and in-service teacher training.

The procedures, techniques and results of the evaluation of minicourses in undergraduate biology have been presented at six

national conventions and in numerous publications (see Appendix F).

In addition to the minicourses which will be published and distributed, two additional developments being used widely are instruments developed by the evaluation staff. They are the Minicourse Evaluation Form (Appendix A) and the Biology Attitude Scale (Appendix C). Numerous requests have been received for their use in other research since no similar instruments are currently available. Both were included as examples in Modular Instruction (Burgess Publishing Company, 1974). Modifications of both forms have been used in numerous research and evaluation studies.

CONCLUSIONS

As part of the evaluation phase of the Minicourse Development Project, twelve schools evaluated different minicourses developed by the Project. The intent was not to evaluate every minicourse produced by the Project, but to evaluate only a sample because of limited available funding. As a consequence of the field testing of the minicourses, the minicourses were revised based upon the feedback received. Consequently, the Project has demonstrated that it is feasible to have "experts" develop and evaluate minicourses so that students in schools not able to produce such materials can benefit from them. The development teams included a subject matter specialist, an educator and students. The evaluation team included an educator, a researcher and a psychologist. Based upon the results of this study, it appears this is a feasible approach to evaluation.

The evaluation procedures also resulted in the dissemination and utilization of the minicourses developed by the Project. Ten

of the participating schools have since adopted the minicourse approach in teaching part or all of their introductory biology courses. One school which had taught all of their undergraduate biology in a traditional lecture-lab approach is now teaching three of their courses in a totally minicourse approach.

Two direct contributions of the evaluation procedures were the development of two necessary evaluation instruments -- the Minicourse Evaluation Form and the Biology Attitude Scale. These instruments were designed and validated by the evaluation staff. Since then they have been widely used in other research and evaluation studies.

SUMMARY

This report provides a brief introduction to the evaluation of minicourses in undergraduate biology. It includes a statement of purpose, outlines the procedures, discusses applications of the research, and provides a concluding statement. The overall purpose of the research was to systematically evaluate a series of minicourses developed by the Minicourse Development Project at Purdue University.

Each of the twelve participating schools evaluated approximately a dozen minicourses each term. The achievement of the students was measured along with any changes in their attitudes toward biology. The students' reactions to the content and components of each minicourse were reported.

The evaluation data were used by a team of instructional developers headed by Dr. Postlethwait to revise and modify the minicourses prior to publication. Other contributions of the project include development and testing of a field-based evaluation procedure

which has since been applied to other instructional development projects. In order to carry out the necessary evaluative procedures, the project staff developed and validated two instruments -- the Minicourse Evaluation Form and the Biology Attitude Scale.

The feasibility of an extensive field-based evaluation program has been demonstrated. Dissemination and adoption procedures have also been tested. Problems were uncovered and solved in most cases. The minicourse approach has been used successfully in a variety of instructional situations and with very diverse student populations.

APPENDIX A
MINICOURSE EVALUATION

Rev. 11-72

Evaluator

Minicourse development is a long and often painstaking process. The minicourse that you have just completed has undergone several modifications and refinements, primarily directed by the constructive criticism of students in the past. As an integral part of our program of minicourse development, YOUR help is needed.

Please read each item carefully and choose the answer (A, B, C, D, or E) that comes *closest* to your feelings on the matter. When you have made your choice, darken in the appropriate bracket for the corresponding item ON THE COMPUTER CARD. DO NOT write on the questionnaire itself. Also, since we are only interested in your FRANK evaluation of the minicourse, please DO NOT write your name on the computer card but please DO be honest in your evaluation. Indicate the title of the minicourse on the TOP of the computer card.

Finally, a separate COMMENT SHEET is provided for any additional comments, criticisms and suggestions you may care to make with respect to the minicourse. Your cooperation is appreciated.

Below are 2 example items. The first item contains a standardized rating scale with 5 anchor points: Strongly Agree (SA); Agree (A); Neither Agree, Nor Disagree (N); Disagree (D); Strongly Disagree (SD).

Example A:

	SA	A	N	D	SD
The United States is in need of a National Health Program. (If you neither agree, nor disagree, blacken in column C on the IBM card.)	A	B	C	D	E

The second type of item on the questionnaire contains an open ended statement to which you will be required to respond more specifically.

Example B:

Current progress in developing a National Health Program has been

A	B	C	D	E
Too slow		About right		Too Fast

(If your feelings more closely correspond to about right, blacken in column C on the IBM card.)

OBJECTIVES

	SA	A	N	D	SD
1. The objectives were very clearly stated.	A	B	C	D	E
2. The materials presented were related to the objectives.	A	B	C	D	E
3. I feel that the stated objectives for this minicourse were achieved.	A	B	C	D	E

AUDIO

	SA	A	N	D	SD
4. Voice quality was very clear.	A	B	C	D	E
5. Speaker's mood was very enthusiastic.	A	B	C	D	E
6. Instructions were clear and easy to follow.	A	B	C	D	E
7. Instructions for the exercises/activities were adequately explained for my knowledge of the topic.	A	B	C	D	E

8. Pacing

A	B	C	D	E
Too slow		About right		Too fast

9. Overall evaluation of audio presentation

A	B	C	D	E
Excellent	Good	Average	Below average	Poor

MORE ITEMS ON REVERSE SIDE

STUDY GUIDE AND HANDOUTS

		SA	A	N	D	SD
10.	The written material was clearly presented.	A	B	C	D	E
11.	The written material was brief and to the point.	A	B	C	D	E
12.	The study guide and audio tape were very well synchronized.	A	B	C	D	E

VISUALS (photos, charts and diagrams)

Note: If there were no visuals in this minicourse, leave questions 13-15 blank.

		SA	A	N	D	SD
13.	In general, the visuals were of excellent quality (clarity).	A	B	C	D	E
14.	The visuals were smoothly presented and integrated within the sequence of the minicourse.	A	B	C	D	E
15.	The visuals were *effective* in contributing to my understanding of the subject matter.	A	B	C	D	E

TANGIBLES (Specimens and models)

Note: If there were no tangibles in this minicourse, leave questions 16-17 blank.

		SA	A	N	D	SD
16.	In general, the tangibles were smoothly presented and integrated within the sequence of the minicourse.	A	B	C	D	E
17.	The tangibles were *effective* in contributing to my understanding of the subject matter.	A	B	C	D	E

GENERAL

		SA	A	N	D	SD
18.	I found this minicourse very stimulating.	A	B	C	D	E
19.	This minicourse was very organized.	A	B	C	D	E
20.	This minicourse was relevant to my interests.	A	B	C	D	E

21. I spent approximately _____ on this minicourse.

A	B	C	D	E
Less than an hour	1 hour	1½ hours	2 hours	more than 2 hours

Please make any additional comments, criticisms and suggestions relevant to this minicourse on the COMMENT SHEET.

Thanks again for your cooperation!

APPENDIX B

SAMPLE EVALUATION DATA

ITEM	NO. A (5)	NO. B (4)	NO. C (3)	NO. D (2)	NO. E (1)	MEAN	STD. DEV.
1	12	17	4	0	0	4.24	.44
2	11	18	3	1	0	4.18	.53
3	10	19	4	0	0	4.18	.40
4	5	21	5	2	0	3.88	.55
5	6	22	4	1	0	4.00	.44
6	10	19	4	0	0	4.18	.40
7	8	21	4	0	0	4.12	.36
8	2	7	24	0	0	3.33	.35
9	7	17	9	0	0	3.94	.50
10	8	16	7	2	0	3.91	.71
11	8	19	3	3	0	3.97	.72
12	9	18	5	0	0	4.13	.44
13	13	15	5	0	0	4.24	.50
14	12	16	5	0	0	4.21	.48
15	14	15	3	1	0	4.27	.58
16	9	17	4	1	0	4.10	.56
17	9	18	3	1	0	4.13	.52
18	9	14	8	2	0	3.91	.77
19	11	15	7	0	0	4.12	.55
20	8	14	9	1	0	3.91	.67
21	1	4	4	11	11	2.13	1.32

APPENDIX C

SAMPLE DATA FOR ACHIEVEMENT RESULTS

MINICOURSE	BIOLOGY Pre	Post 1	Post 2
Complementarity of Structure and Function (6)**			
Leaf (8)	18	71	72
Meiosis (8)	9	57	48
Multicellularity (7)	26	46	74
Transformation of Energy I (8)	33	67	71
Means	22	60	66

*Scores given in percentages (rounded off to nearest percent)

**Number in parenthesis denotes number of items

APPENDIX D

SAMPLE ITEM ANALYTIC DATA FOR ACHIEVEMENT TESTS

ITEM	PROPORTION CHOOSING EACH ALTERNATIVE				
	A	B	C	D	E
1	0.174	0.0	0.783*	0.043	0.0
2	0.391*	0.043	0.478	0.087	0.0
3	0.130	0.304	0.435*	0.130	0.0
4	0.348*	0.304	0.217	0.130	0.0
5	0.174	0.348	0.391*	0.087	0.0
6	0.0	0.0	0.043	0.957*	0.0

ITEM	ALTERNATIVE CORRELATION WITH TOTAL SCORE				
	A	B	C	D	E
1	-0.600	0.0	0.478*	0.149	0.0
2	0.559*	-0.493	-0.292	-0.094	0.0
3	-0.507	-0.107	0.436*	0.011	0.0
4	0.509*	0.082	-0.267	-0.507	0.0
5	-0.140	0.326	0.113*	-0.558	0.0
6	0.0	0.0	-0.065	0.065*	0.0

APPENDIX E
STUDENT ATTITUDE SCALE

Each of the statements below expresses a feeling toward biology. Please rate each statement on the extent to which you agree. For each, you may: (A) Strongly Agree, (B) Agree, (C) be Undecided, (D) Disagree, or (E) Strongly Disagree.

After you have made your choice, blacken in the appropriate response in the columns on the IBM card corresponding to each item.

A	B	C	D	E
Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

1. Biology is very interesting to me.
2. I don't like biology, and it scares me to have to take it.
3. I am always under a terrible strain in a biology class.
4. Biology is fascinating and fun.
5. Biology makes me feel secure, and at the same time it is stimulating.
6. Biology makes me feel uncomfortable, restless, irritable and impatient.
7. In general, I have a good feeling toward biology.
8. When I hear the word biology, I have a feeling of dislike.
9. I approach biology with a feeling of hesitation.
10. I really like biology.
11. I have always enjoyed studying biology in school.
12. It makes me nervous to even think about doing a biology experiment.
13. I feel at ease in biology and like it very much.
14. I feel a definite positive reaction to biology; it's enjoyable.

Below are some scales on which we would like you to rate your feelings toward biology. On each scale, you can rate your feelings toward biology as a 1, 2, 3, 4, or 5. THERE ARE NO CORRECT ANSWERS. Also, some of the scales seem to make more sense than others. Don't worry about it. Just rate your feelings toward biology on these scales as best you can. Please don't leave any scales blank.

For your response to each scale, blacken in the appropriate box on the IBM card.

BIOLOGY IS:

15.	Good	A	B	C	D	E	Bad
16.	Clean	A	B	C	D	E	Dirty
17.	Worthless	A	B	C	D	E	Valuable
18.	Cruel	A	B	C	D	E	Kind
19.	Pleasant	A	B	C	D	E	Unpleasant
20.	Sad	A	B	C	D	E	Happy
21.	Nice	A	B	C	D	E	Awful
22.	Fair	A	B	C	D	E	Unfair

APPENDIX F

Presentations at National Conventions:

"The Effect of Pretesting on the Achievement of Students using Audio-Tutorial Minicourses" by James Russell at the 1974 National Convention of the Association for Educational Communications and Technology, Atlantic City, New Jersey, March 19, 1974

"Minicourse Development Project: First Year of Field Testing in Review" by James Russell at the Fifth Annual International Audio-Tutorial Congress Conference at Ohio State University, Columbus, Ohio, November 6, 1973

"Evaluation Techniques in Audio-Tutorial Instruction" by James Russell at the Association for Educational Communications and Technology National Convention, Las Vegas, Nevada, April 9, 1973

"The Development of a Minicourse Evaluation Form" by James Russell at the Fourth Annual Convention of the International Audio-Tutorial Congress, Columbia, South Carolina, November 3, 1972

Multi-media presentation on the Audio-Tutorial System for the Biological Sciences including evaluation by James Russell at the Tenth Annual Convention of the National Society for Programmed Instruction at New Orleans, Louisiana, March 16, 1972

"The Evaluation of Minicourses during Field Testing" by James Russell at the Third Annual Audio-Tutorial Systems Conference at Purdue University, Lafayette, Indiana, November 2, 1971

Publications and publications pending:

"The Development, Validation and Application of Attitude Scales" by James Russell and Stephen Hollander submitted to Improving Human Performance: A Research Quarterly of the National Society for Performance and Instruction

"Field Test Results of Six Minicourses Evaluated at Olivet Nazarene College During the Spring of 1973" by Harry Fulton and James Russell submitted to The American Biology Teacher

"Techniques for Evaluating Minicourses" by James Russell submitted to The American Biology Teacher

"The Effect of Pretesting on the Achievement of Students using Audio-Tutorial Minicourses" by James Russell submitted to The American Biology Teacher